

Research Review

Listerine® Review

About the reviewers

Dr Jonathan Leichter, DMD, Cert Perio (Harvard)

Dr Leichter is currently Senior Lecturer in the Department of Oral Sciences at the University of Otago. Dr Leichter joined the faculty after 20 years in fulltime private practice in New York and Boston, 18 of which were spent in specialist practice limited to periodontology and implant dentistry. Trained at Tufts University and obtaining his specialist training at Harvard University, he has been actively involved in clinical dental implant practice since 1984. Since 2002, he has supervised and mentored postgraduate students in periodontology, endodontics and prosthodontics. His research interests and publications are in the field of periodontology, dental trauma and laser applications in dentistry.

Esther Devaney, Dip D.H.

Esther received her Diploma in Dental Hygiene from the University of Otago. In addition to her Diploma, she has a Certificate in Enrolled Nursing. Esther is a Professional Practice Fellow at the University of Otago, teaching in the Bachelor of Oral Health Programme and she maintains a private dental hygiene practice in Dunedin.

Disclaimer: This publication is an independent review of significant research for Listerine. It provides summaries and opinions of published data that are the opinion of the writer rather than that of the scientific journal or research group. It is suggested the reader reviews the full trial data before forming a final conclusion on any recommendations.

This review discusses the evidence in support of the use of Listerine® antimicrobial mouthrinses in conjunction with brushing and flossing for keeping gums healthy and reducing dental plaque and gingivitis.

Rationale for using Listerine antimicrobial mouthrinses

An accumulation of scientific and clinical data attest to the efficacy, tolerability and safety of Listerine Antiseptic mouthrinse formulations, clearly demonstrating how they inhibit the bacterial activity in dental plaque that can cause gingivitis, an early, reversible form of periodontal (gum) disease. In the dental surgery, when used as a subgingival irrigant prior to scaling, Listerine greatly reduces the anaerobic and aerobic bacteria associated with bacteraemia, and preprocedural rinsing with Listerine greatly reduces the number of bacteria aerosolised during dental procedures.¹ After periodontal surgery, Listerine assists with wound healing and aids in plaque control.¹ Periodontal diseases are complex disorders that are triggered by the accumulation of dental plaque, and the clinical signs are caused by the resultant inflammatory and immune responses.² Limiting the accumulation of dental plaque is an important part of controlling the development and progression of periodontal diseases.² When included as an adjunct to the patient's daily oral hygiene regimen that includes brushing and flossing, the significant, incremental benefit that Listerine antimicrobial mouthrinses provide against plaque and in achieving gingivitis control enable them to play an essential role in disease management. Patients with extensive crowns and bridges, implants, and orthodontics can also benefit from the use of Listerine antimicrobial mouthrinse.^{3,4}

Mechanical plaque control methods alone provide insufficient oral hygiene

Theoretically, mechanical methods alone are sufficient for maintaining a level of oral hygiene sufficient to control gingivitis. However, clinical studies reflect the difficulty in accomplishing effective plaque removal by the vast majority of people on an ongoing basis.⁵⁻¹³ These data provide a clear rationale for incorporating effective antimicrobial measures, such as use of an antimicrobial mouthrinse, into daily oral hygiene regimens. Indeed, researchers have suggested that, from the perspectives of both individual health and general public health, the daily use of antimicrobial measures shown to have significant antiplaque/antigingivitis activity would be a meaningful, cost-effective addition to mechanical oral hygiene methods.¹³⁻¹⁵

It has been established that the oral mucosae serve as reservoirs of pathogenic bacteria that can be transferred to the tooth surface, providing further rationale for supplementing mechanical plaque control methods with effective antimicrobial mouthrinses; such products would deliver antimicrobial agents to mucosal sites throughout the mouth that are unaffected by mechanical plaque control methods.¹⁶⁻²⁰ Studies have demonstrated the effectiveness of rinsing with an antimicrobial mouthrinse in significantly reducing both salivary^{21,22} and mucosal²³ levels of bacteria. The addition of an antimicrobial mouthrinse to daily oral hygiene regimens would help reduce the total oral bacterial burden and thereby could complement a direct action on bacteria contained within the plaque biofilm itself.

Comparisons of antimicrobial mouthrinses

Chlorhexidine is the active ingredient in prescription mouthrinses such as Peridex®, the only prescription mouthrinse to have received the American Dental Association (ADA) Seal of Acceptance for the control of supragingival plaque and gingivitis.²⁴ The only over-the-counter antimicrobial mouthrinse to be given the ADA Seal of Acceptance for this indication is Listerine Antiseptic, a fixed combination of essential oils.²⁵ Clinical studies have demonstrated comparable antigingivitis efficacy between Peridex and Listerine Antiseptic.^{26,27} However, the antimicrobial activity of chlorhexidine may be significantly reduced by its interaction with common toothpaste ingredients, such as sodium lauryl sulphate.^{28,29} It has been proposed that patients should delay rinsing for at least for at least 30 minutes to 2 hours after brushing to minimise reduction in antiplaque activity.^{28,29} In addition, chlorhexidine has been linked to local side effects including disturbance of taste and notably staining of the teeth, tongue, and restorative materials, as listed in the Peridex prescribing information.^{29,30}

Cetylpyridinium chloride (CPC) is another ingredient that is included in a number of cosmetic and therapeutic mouthrinse formulations. No CPC-containing mouthrinse currently carries the ADA Seal of Acceptance for plaque and gingivitis

reduction. Not all clinically tested CPC formulations have demonstrated supragingival plaque and gingivitis efficacy.^{31,32} Furthermore, scant long-term clinical evidence exists in support of the efficacy of CPC mouthrinses against supragingival plaque and gingivitis.^{33,34}

As with chlorhexidine, the antimicrobial activity of CPC may be affected by toothpastes, especially if the rinse is used immediately after brushing; it has been recommended that patients rinse with water or wait for a period of time after brushing before using the rinse.³⁵ In addition, increases in extrinsic tooth stain have been seen in short-term studies investigating CPC-containing mouthrinses,³¹ while long-term clinical studies have demonstrated that CPC-containing mouthrinses are associated with clinically significant increases in objectionable tooth stain.^{32,33}

In contrast to chlorhexidine- and CPC-containing mouthrinses, no interactions have been documented between essential oil-containing mouthrinses and toothpaste ingredients; rinsing with water is not required after brushing and prior to rinsing with Listerine Antiseptic. In particular, Listerine mouthrinses do not promote calculus formation and are not linked with the potential drawbacks of other mouthrinse ingredients.²⁶

Safety of antimicrobial mouthrinses

The majority of mouthrinses with antiplaque properties, including Listerine mouthrinses, contain pharmaceutical-grade denatured alcohol as a vehicle to deliver antimicrobial ingredients; alcohol provides solubility, preservability and germicidal activity.³⁶ An extensive review recently investigated the validity of concerns raised regarding the potential for alcohol-containing rinses to cause adverse effects, including

increasing the risk of developing oral cancer, xerostomia and burning or irritation.³⁶ The review concluded that the abundant clinical data have demonstrated the safety of alcohol-containing mouthrinses, and failed to find any evidence for a relationship between these products and the above-mentioned safety concerns.

Influencing patient compliance

Patients' adherence to a daily regimen that includes the use of an oral antimicrobial rinse in conjunction with brushing and flossing is important to achieve successful outcomes.³⁶ However, only 30% to 50% of patients are highly compliant with suggested oral hygiene procedures for up to 30 days after receiving instructions.³⁷ Understanding the reasons for nonadherence and adapting oral health care recommendations to patients' specific needs, goals and levels of readiness may facilitate lasting behavioural change. Certain methods have been developed from practice-based dental research, in an attempt to help improve patients' adherence to a daily oral health care regimen that includes brushing, flossing and rinsing (see opposite).³⁶

- Simplify recommendations and use language that patients can understand
- Accommodate patients' specific abilities, motivations and lifestyles and modify oral health care instructions accordingly
- Remind patients of appointments
- Inform patients by providing them with a written copy of recommendations
- Provide positive feedback and reinforcement
- Identify potential noncompliers and discuss with them the possible consequences of noncompliance/nonadherence (that is, increased risk of developing plaque and gingivitis) before therapy begins

Risk assessment and disease management in daily dental practice

It has been noted that the role of risk assessment and disease management has become increasingly important, as dental professionals seek to optimise treatment and improve outcomes for patients.³⁸ Indeed, including risk assessment and disease management in daily practice means that dentists may favourably affect patient outcomes both in the general population and within groups at increased risk of developing periodontal diseases.³⁸ Dental practitioners are urged to consider it to be their responsibility to disseminate this information and influence their patients' adherence to a daily oral care regimen that includes brushing, flossing and rinsing.³⁸

Listerine has received the American Dental Association Seal of Acceptance for helping to prevent and reduce supragingival plaque and gingivitis. All flavours of Listerine Antiseptic mouthrinses contain the same fixed combination of four essential oils: eucalyptol (0.092%); menthol (0.042%); methyl salicylate (0.060%); and thymol (0.064%). Formulations available in New Zealand are Listerine Original, Listerine Antiseptic, Listerine Cool Mint, Listerine Citrus Fresh, Listerine Teeth Defence, Listerine FreshBurst, Listerine Tartar Control, Listerine Whitening and Listerine PocketPaks.

Major studies show antiplaque and antigingivitis efficacy

Comparative efficacy of an antiseptic mouthrinse and an antiplaque/antigingivitis dentifrice: A six-month clinical trial³⁹

Authors: Charles CH et al

Summary: When used in conjunction with usual oral hygiene for six months, Listerine Antiseptic or Colgate® Total resulted in clinically and statistically significant reductions in plaque and gingivitis. Although reductions in gingivitis and bleeding were similar with the two products, Listerine Antiseptic provided a significantly greater benefit in reducing plaque.

Method: 316 subjects with mild-to-moderate gingival inflammation and plaque were given a dental prophylaxis to remove all supragingival plaque, stain and calculus. Subjects were randomly assigned to one of three groups: L group (control toothpaste/Listerine Antiseptic rinse), T group (Colgate Total fluoride toothpaste/control rinse) or the negative control group P (control toothpaste/control rinse). On the same day as the prophylaxis, subjects began brushing with their assigned dentifrice for 60 seconds, followed by rinsing for 30 seconds with 20ml of their assigned mouthrinse, twice daily, unsupervised at home for six months.

Results: At 3 and 6 months, scores on the Modified Gingival Index (MGI), Bleeding Index (BI) and Plaque Index (PI) were significantly lower for subjects in the L and T groups, compared with those in the P group (see Table 1). At 6 months, the magnitude of reduction for the L group was 22.9%, 70% and 56.1%, respectively; corresponding values for the T group were 20.8%, 58% and 22.1%, respectively. Both groups demonstrated similar reductions in gingivitis and bleeding, but the L group had a statistically significantly lower 6-month whole-mouth mean PI score than the T group ($p < 0.001$), with a difference of 43.6%.

Comment: Dr Jonathan Leichter: This study compared the efficacy of an essential oil-containing antiseptic mouth rinse (Listerine) with an antiplaque/antigingivitis toothpaste (Colgate Total) using 316 subjects over a six-month period. Subjects were divided into 3 groups, namely Control toothpaste/Listerine rinse, Colgate Total toothpaste/Control rinse and Control toothpaste/control rinse. Although both the Listerine and the Colgate Total groups demonstrated significantly lower visual signs of gingivitis (MGI), BI and PI than the control group, the magnitude of reduction for the Listerine group was greater for both the BI and the PI. From a clinical point of view, it would be advisable for clinicians to recommend the use of Listerine mouthwash as an addition to the patient's regular oral hygiene practices in those cases where more effective plaque control is needed. Examples that immediately spring to mind are our adolescent orthodontic patients, patients with impaired motor skills,

Table 1. Outcomes at three and six months for control, Listerine Antiseptic and Colgate Total groups

Variable	Adjusted* Mean Scores		
	Control (P)	Listerine Antiseptic (L)	Colgate Total (T)
MGI			
Three months	2.00	1.74***	1.80**
Six months	1.93	1.49**	1.53**
GSI			
Three months	0.080	0.016**	0.029**
Six months	0.087	0.008**	0.005**
BI			
Three months	0.110	0.048**	0.058**
Six months	0.129	0.039***	0.054**
PI			
Three months	2.36	1.52***	2.07**
Six months	2.16	0.95***	1.68**
PSI			
Three months	0.36	0.12***	0.28**
Six months	0.32	0.04***	0.18**

* Corresponding baseline measurement used as the covariate; **MGI** Modified Gingival Index; **GSI** Gingivitis Severity Index; **BI** Bleeding Index; **PI** Plaque Index; **PSI** Plaque Severity Index; † Statistically significantly different from the Colgate Total group ($p < 0.05$); **Statistically significantly different from the control group ($p < 0.001$).

or, in fact, any patient who could benefit from a little extra help in this department.

Esther Devaney: It would appear that most patients with mild-to-moderate gingival inflammation would benefit from a home care regime of regular twice-daily toothbrushing in conjunction with a suitable mouthrinse. In this study of over 300 subjects, there were no product-related adverse events reported. A clinician would have confidence in recommending essential oil-containing mouthrinses to their patients. In the method section, I noted that toothbrushing was recommended for 1 minute and the rinse 20 mls for 30 seconds twice daily. The usual recommendation as a clinician I would give is 2 minutes of toothbrushing, which would possibly alter the MGI, bleeding on probing and PI results.

Comparative clinical trial of two antigingivitis mouthrinses⁴⁰

Authors: Witt JJ et al

Summary: Rinsing twice daily with the experimental alcohol-free 0.07% Crest Pro-Health Rinse (CPC) provides antiplaque and antigingivitis efficacy similar to that of the positive control rinse (Cool Mint Listerine, containing essential oils and 21.6% ethyl alcohol [EO]).

Method: 78 healthy adults were enrolled in this study, which involved an initial 4-week phase during which subjects were given a prophylaxis and instructions to brush twice daily in a manner to approach optimum gingival health. Subjects were then randomised to 21 days of treatment, using 20 ml of their assigned product (CPC rinse or EO rinse) for 30 seconds after brushing twice daily. Plaque removal by brushing was prevented during the treatment phase for one mandibular quadrant (experimental gingivitis region) by means of a specially-manufactured tooth shield.

Results: Results are reported for 75 completers. No statistically significant differences were detected between the two treatment groups for scores on the Modified Gingival Index, Gingival Bleeding Index, or Modified Quigley-Hein Plaque Index. Results were similar for shielded interproximal sites. Both treatments showed good tolerability.

Comment: Dr Jonathan Leichter: The purpose of this study was to compare the safety as well as the antiplaque and antigingivitis efficacy of two oral rinses, the experimental Crest Pro-Health Rinse and the positive control Cool Mint Listerine. Seventy-five healthy adults

completed the study which spanned a 4-week pre-baseline period during which the subjects brushed twice daily, followed by a 21-day treatment phase during which the subjects used their assigned product after their twice-daily brushing.

It was found that rinsing twice daily with either mouth rinse produced the same results. There was no statistical difference between the groups and both treatments were well tolerated. One of the main differences between the two mouthrinses used in this study is their alcohol content. The Crest Pro-Health Rinse is an alcohol-free cetylpyridinium chloride rinse, while Cool Mint Listerine contains essential oils and 21.6% ethyl alcohol. It is good to know that patients unable to use the mouthrinse containing alcohol (for whatever reason), will not be disadvantaged, provided they brush twice daily in addition to use of their mouthrinse. It is also reassuring that, in the short term, there were no problems relating to the alcohol content of the Listerine.

Esther Devaney: Again, it appears that the use of a mouthrinse pre- or post-brushing (in this study post-brushing) can be beneficial to most patients without any adverse reactions, regardless of alcohol content. The absence or presence of alcohol did not appear to have a significant impact on the results achieved in this study. However, in my clinical practice, if I were to detect xerostomia in one of my patients, it may be preferable to use an alcohol-free mouthrinse,

The effect of a mouth rinse containing phenolic compounds on plaque formation and developing gingivitis⁴¹

Authors: Sekino S, Ramberg P

Summary: During a 2-week period of no mechanical oral hygiene, significantly less plaque formed and less gingivitis developed when the study participants rinsed with the Listerine mouthwash than with the saline solution (negative control). Significantly more plaque formed during the Listerine than during the 0.1% chlorhexidine period (CHX; positive control), but gingival bleeding rates did not significantly differ between the two rinse regimens.

Method: This study enrolled 21 subjects, who underwent a 2-week period including oral hygiene instruction, scaling and professional mechanical tooth cleaning, prior to a 2-week experimental period, in which the participants were told to abstain from all mechanical plaque-control measures but to rinse twice daily with 10ml of the assigned solution (test: Listerine, positive control: 0.1% CHX, negative control: saline) for 60 seconds.

Results: During the experimental periods, significantly less plaque formed and less gingivitis developed when participants rinsed with the Listerine mouthwash than with saline solution. However, significantly more plaque formed during the Listerine than during the CHX rinse period, although there was no significant difference in the development of gingival bleeding between the two rinse regimens. Supragingival plaque samples revealed significantly smaller proportions of motile rods and fusiforms in the Listerine and CHX groups than in the negative control group. The mean increase in the lactoferrin/albumin ratio in the Listerine group was significantly smaller than that in the negative control group but significantly larger than in the CHX group.

Comment: Dr Jonathan Leichter: The thought of not brushing one's teeth for 2 weeks is, for any dental health professional, a rather unappealing idea. In this study, 21 subjects accepted the challenge and did just that. They were, however, instructed to rinse twice a day for 60 seconds. Three experimental periods followed – a test period with Listerine, a positive control period with 0.1% chlorhexidine, and a negative control period during which the subjects rinsed with saline. Prior to the start of each trial period, there was a 2-week period that included oral hygiene instruction, scaling and a professional mechanical tooth cleaning.

Not surprisingly, it was found that significantly less plaque formed and less gingivitis developed during the Listerine period as compared with the saline period of the trial. Interestingly, when the Listerine and the chlorhexidine periods were compared, more plaque formed during the Listerine period, but there was no significant difference when comparing

Mean GI scores at sites with different QHI scores

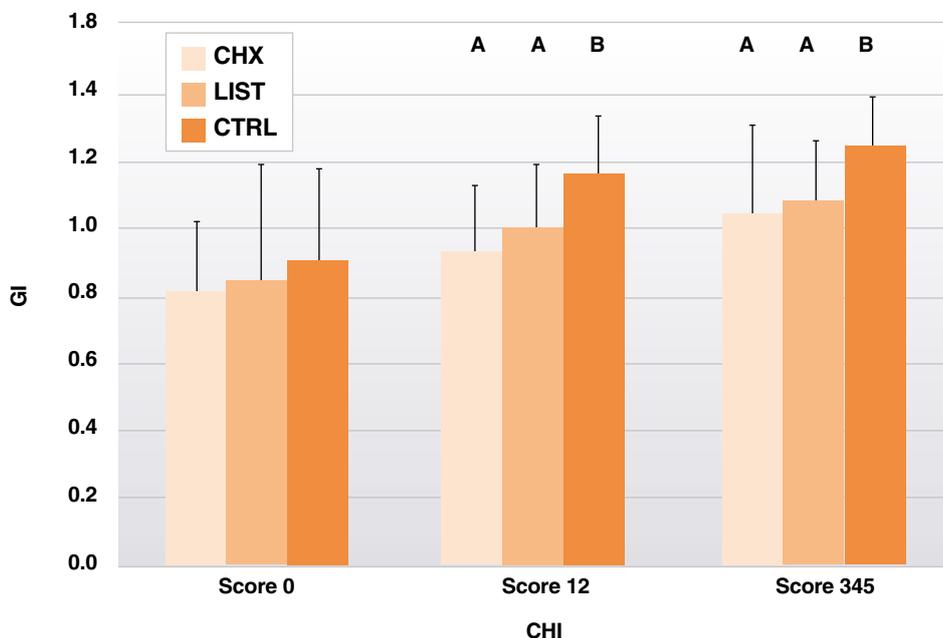


Fig. 1. Mean GI at sites with different QHI scores on Day 14. Different letters indicate a statistically significant difference (SNK test). QHI, Quigley-Hein Index; GI, Gingival Index; CHX, chlorhexidine; LIST, Listerine; CTRL, control; SNK, Student-Neumann-Keuls.

gingival bleeding. It would appear that Listerine has more of an effect on gingivitis than on plaque formation and suggests possible anti-inflammatory effects. For the past 100 years, the treatment of periodontal diseases has centred on bacterial plaque control. New developing strategies aimed at targeting the host response to the bacteria, rather than the bacteria themselves, may bring a new approach to this ongoing and challenging problem.

Esther Devaney: It would be unusual in a day-to-day dental practice to have patients with no mechanical oral hygiene practice but this study would be of great interest to Intensive Care Units, hospice facilities and palliative care/disabled or dementia patients, where oral hygiene practices are problematic.

While this study shows that a chlorhexidine rinse may be more effective in reducing plaque formation, clinicians are wary about the long-term use of this product due to its recognised side effects of increased staining, altered taste sensation, and increased calculus deposits. Listerine may be preferred, as the side effects appear to be negligible and the improved reduction in inflammation (rather than decrease in plaque accumulation) may ultimately be the most important factor in the treatment of periodontal diseases.

In vivo antimicrobial effectiveness of an essential oil-containing mouth rinse 12 h after a single use and 14 days' use⁴²

Authors: Fine DH et al

Summary: Rinsing with a Listerine mouthrinse produces long-lasting effects in reducing anaerobic bacteria overall as well as Gram-negative anaerobes and volatile sulphur compound (VSC)-producing organisms.

Method: Outcomes are reported from two studies. Bacteria samples were taken from supragingival plaque and the dorsum of the tongue, then subjects began twice-daily rinsing with either an essential oil mouthrinse containing 0.09% zinc chloride (Tartar Control Listerine Antiseptic) or a negative control rinse. Bacterial sampling was repeated 12 h after the first rinse, and again 12 h after the final rinse 14 days

later. The sampling schedule was adjusted according to investigations of daytime or night-time activity.

Results: Mean bacterial counts were significantly lower in samples taken from subjects using the Listerine rinse than in those using the control rinse, for all comparisons ($p \leq 0.005$), i.e., tongue and supragingival plaque samples for each of three media (total anaerobes, Gram-negative anaerobes and VSC-producing organisms) in the daytime and night-time studies (see Table 2). Mean bacterial count percent reductions ranged from 56.3 to 95.3 for plaque samples and from 61.1 to 96.1 for tongue samples. A trend to higher reductions was seen after 14 days' rinsing compared with after the initial rinse.

Continued on page 5

Table 2. Inter-group comparisons for bacterial samplings in daytime and night-time studies – 12 h after 14 days' use (evaluative subjects)

Comparison	Difference in means	Percent reduction*	p-value
Daytime Study			
EO rinse versus control, STA medium			
Dental plaque samples (7.08 [†] vs 8.27)	-1.19	93.5	<0.001
Tongue swab samples (6.87 vs 8.08)	-1.21	93.8	<0.001
EO rinse versus control, SNV medium			
Dental plaque samples (6.33 vs 7.54)	-1.21	93.8	<0.001
Tongue swab samples (6.23 vs 7.41)	-1.18	93.4	<0.001
EO rinse versus control, OOPS medium			
Dental plaque samples (4.72 vs 5.28)	-0.56	72.5	<0.001
Tongue swab samples (4.64 vs 5.23)	-0.59	74.3	<0.001
Night-time Study			
EO rinse versus control, STA medium			
Dental plaque samples (6.68 [†] vs 8.01)	-1.33	95.3	<0.001
Tongue swab samples (6.68 vs 8.09)	-1.41	96.1	<0.001
EO rinse versus control, SNV medium			
Dental plaque samples (5.67 vs 7.0)	-1.33	95.3	<0.001
Tongue swab samples (6.47 vs 7.65)	-1.18	93.4	<0.001
EO rinse versus control, OOPS medium			
Dental plaque samples (4.88 vs 5.32)	-0.44	63.7	<0.001
Tongue swab samples (4.82 vs 5.67)	-0.85	85.9	<0.001

*Percent reduction = $(1 - 10^{\text{diff}}) \times 100$, where diff is the difference in means in log₁₀ scale.

[†]Log₁₀ CFU/ml adjusted means.

EO Essential oil mouthrinse; STA Schaedlers medium; SNV Schaedlers Nalidixic/Vancomycin medium; CFU colony-forming units.

Comment: Dr Jonathan Leichter: These two studies looked at both short- and longer-term effects of rinsing with Tartar Control Listerine Antiseptic mouthwash. Baseline sampling of bacteria from both supragingival plaque and the dorsum of the tongue was done before the subjects began rinsing twice a day with either the Tartar Control Listerine Antiseptic mouthwash or a negative control rinse. 12 h after the first rinse and again 12 h after the final rinse, bacterial sampling was repeated. The results of this study showed that the mean bacterial counts were significantly lower in those subjects who used the Listerine mouth rinse with a higher reduction found at the 14-day sampling.

Reducing anaerobic bacteria, Gram-negative anaerobes and VSC-producing bacteria can play a key role in the reduction of plaque and gingivitis. The use of Listerine mouthwash, particularly over a longer period of time, can contribute not only to an improvement in gingival health but can also be an effective strategy in combating the problem of bad breath due to the reduction in VSC-producing organisms. Many of our patients (and their friends) could benefit from this.

Esther Devaney: It would appear from this study that there are significant benefits obtained from the regular use of essential oil-containing antimicrobial mouth rinse, most notably for the reduction of supragingival plaque and gingivitis and for the suppression of bacteria on the dorsum of the tongue, a primary factor in oral malodour.

The introduction of a tongue cleaner or scraper combined with the essential oil mouthrinse may offer a further step for the reduction of oral malodour, especially if a heavy coated tongue were noted on clinical examination.

Effects of an essential oil-containing antiseptic mouth rinse on plaque and salivary *Streptococcus mutans* levels⁴³

Authors: Fine DH et al

Summary: As an adjunct to daily oral hygiene procedures, twice-daily rinsing with Listerine Antiseptic reduces the levels of recoverable *Streptococcus mutans* and total streptococci in supragingival interproximal plaque and in saliva.

Method: Saliva and plaque samples from 29 subjects were quantified at baseline for recoverable *S. mutans* and total streptococci, and then subjects were randomised to either the essential oil mouthrinse or a sterile water control. They were asked to rinse with 20 ml for 30 seconds twice a day for 11 days and once on the 12th day, in addition to their usual oral hygiene procedures. A follow-up *in vitro* study investigated differential susceptibilities of different strains of streptococci subjected to the antiseptic mouthwash.

Results: On day 12, the mouthrinse was associated with reductions from baseline in plaque of 75.4% in total recoverable *S. mutans* and of 69.9% in streptococci; corresponding reductions in saliva were 39.2% and 50.5%, respectively (see Table 3). According to the *in vitro* results, streptococci from the *S. mutans* group were more susceptible to the bactericidal activity of the mouthrinse than streptococci from the *S. mitis* group.

Comment: Dr Jonathan Leichter: Due to the role that *S. mutans* plays in the development of dental caries, any product that can significantly reduce the numbers of these bacteria, in both plaque and saliva, has an important role to play. This study was carried out to determine the effect that a twice-daily rinsing with Listerine Antiseptic had on levels of *S. mutans* and total streptococci in supragingival interproximal plaque and in saliva. The results were very promising. Levels of *S. mutans*, which is the most cariogenic of all the oral streptococci, were reduced by 75.4% in plaque and 39.2% in saliva.

This study provides an evidence-based reason for recommending the use of an essential oil mouthrinse (such as Listerine Antiseptic) not

only to those patients whose oral hygiene procedures are inadequate, but also to any patient who has a moderate to high caries risk. It can provide an additional preventative step in their usual daily oral hygiene procedures.

Esther Devaney: This interesting study shows the benefit of combining an essential oil-containing mouthrinse with the standard oral hygiene practice of tooth brushing and flossing, not only for our patients with inflammatory periodontal disease, but for the control of cariogenic bacteria as well. The introduction of *S. mutans*-suppressing mouthrinses along with fluoride toothpaste and remineralising agents such as Tooth Mousse may be a valuable preventative strategy for our high caries-risk patients.

Table 3. *Streptococcus mutans* counts, at baseline and day 12

n	Water control 27	Essential oil rinse 27
Saliva		
baseline mean	4.39	4.38
post-rinse adjusted mean	4.40	4.18
between-treatment p-value		0.0012
Interproximal plaque		
baseline mean	3.37	3.43
post-rinse adjusted mean	3.39	2.78
between-treatment p-value		<0.001

*Log₁₀ transformed counts.

Comparative effectiveness of an essential oil mouthrinse and dental floss in controlling interproximal gingivitis and plaque⁴⁴

Authors: Sharma NC et al

Summary: Listerine Antiseptic is at least as good as dental floss in the control of interproximal gingivitis and provides significantly greater plaque reduction.

Method: 319 adults (aged 18–63 years) were randomly allocated to 1 of 3 groups: essential oil mouthrinse (Listerine Antiseptic); dental floss (Reach Dental Floss); or a negative control rinse. At baseline, subjects were given a complete oral soft tissue examination and scored on the Modified Gingival Index (MGI), modified Quigley-Hein Plaque Index (PI), and Bleeding Index (BI). After receiving a complete dental prophylaxis and flossing or rinsing instructions, subjects commenced their respective regimen and continued unsupervised at home, in addition to toothbrushing, and were re-examined at 3 and 6 months.

Results: Of a total of 301 evaluable patients, mean interproximal MGI scores at 3 and 6 months were significantly lower in both the Listerine and floss groups than the negative control group ($p < 0.001$). According to statistical criteria, Listerine was at least as good as flossing for the control of interproximal gingivitis. At 3 and 6 months, interproximal PI scores were significantly lower in the Listerine group than in the floss and negative control groups ($p < 0.001$ for all comparisons), while dental flossing was significantly more effective than the negative control at 3 months ($p < 0.05$) but not at 6 months.

Comment: Dr Jonathan Leichter: When it comes to flossing, patient compliance is notoriously low. Many patients find floss difficult to manipulate while the majority simply cannot be bothered. This 6-month study looked at three groups; one used Listerine Antiseptic mouthrinse, the second dental floss, while the third group used a negative control rinse. All groups still brushed their teeth and were examined at baseline, after 3 months and finally, at 6 months. It was found that the essential oil mouthrinse (Listerine) was “at least as good as” dental floss for the control of interproximal gingivitis. With regard to interproximal plaque control, the Listerine mouthwash was significantly more effective than floss at both the 3-month and 6-month examinations. While I am sure all dental health professionals will still continue to encourage all patients to floss, it is heartening to know that there is another effective alternative available for those patients who either cannot, or will not, embrace the flossing habit.

Esther Devaney: The benefit of an essential oil-containing mouthrinse combined with flossing is an ideal combination for patients to achieve effective oral hygiene when combined with tooth brushing. While the flossing control group showed significantly more effective results than the negative control at 3 months but not at 6 months, it would appear the patient’s motivation to floss may wane by 6 months. With continued use of an essential oil-containing mouthrinse combined with tooth brushing, the patient may still obtain significant benefits.

CONCLUSION – Dr Jonathan Leichter

While toothbrushing, flossing and interproximal cleaning aids have the potential to provide optimal levels of oral hygiene, our clinical experience clearly tells us that many of our patients fail to use these mechanical cleaning methods as directed. Additional help in controlling bacterial plaque is the basis for patients using antimicrobial mouthrinses as adjuncts to control bacterial plaque and the associated inflammation.

Essential oil-containing mouthrinses are safe and clinically effective in reducing plaque and gingivitis. The use of antimicrobial mouthrinses in conjunction to mechanical plaque control can provide significant benefits to patients who cannot maintain adequate levels of plaque and gingivitis control through mechanical methods alone. Dentists should feel confident in recommending product, such as essential oil mouthrinses, which have proven clinical activity, demonstrated safety and clinical effectiveness.

References

- Ciancio S. Expanded and future uses of mouthrinses. 1994;125 Suppl 2:29S-32S.
- Lamster IR. Antimicrobial mouthrinses and the management of periodontal diseases. J Am Dent Assoc 2006;137 Suppl 11:5S-9S.
- Tufekci E et al. Effectiveness of an essential oil mouthrinse in improving oral health in orthodontic patients. Angle Orthod 2008;78:294-298.
- Fine DH et al. Effect of an essential oil-containing antimicrobial mouthrinse on specific plaque bacteria in vivo. J Clin Periodontol 2007;34:652-657.
- Morris AJ et al. The oral cleanliness and periodontal health of UK adults in 1998. Br Dent J 2001;191:186-192.
- Williams K et al. One- and 3-minute plaque removal by a battery-powered versus a manual toothbrush. J Periodontol 2004;75:1107-1113.
- Christensen LB et al. Self-reported oral hygiene practices among adults in Denmark. Community Dent Health 2003;20:229-235.
- Segelnick SL. A survey of floss frequency, habit and technique in a hospital dental clinic & private periodontal practice. NY State Dent J 2004;70:28-33.
- American Dental Association. 2003 public opinion survey: Oral health of the US population. Chicago: American Dental Association; 2004.
- Bakdash B. Current patterns of oral hygiene product use and practices. Periodontol 2000 1995;8:11-14.
- Hugoson A et al. Oral hygiene and gingivitis in a Swedish adult population 1973, 1983 and 1993. J Clin Periodontol 1998;25:807-812.
- Albandar JM, Kingman A. Gingival recession, gingival bleeding, and dental calculus in adults 30 years of age and older in the United States, 1988-1994. J Periodontol 1999;70:30-43.
- Christersson LA et al. Dental plaque and calculus: risk indicators for their formation. J Dent Res 1992;71:1425-1430.
- van der Weijden GA, Hioe KP. A systematic review of the effectiveness of self-performed mechanical plaque removal in adults with gingivitis using a manual toothbrush. J Clin Periodontol 2005;32(Suppl 6):S214-S228.
- Barnett ML. The role of therapeutic antimicrobial mouthrinses in clinical practice: control of supragingival plaque and gingivitis. J Am Dent Assoc 2003;134:699-704.
- Fine DH et al. Chemotherapeutic mouthrinses as an adjunct in the initial phases of periodontal treatment. Am J Dent 1989;2:309-316.
- Kononen E. Development of oral bacterial flora in young children. Ann Med 2000;32:107-112.
- Liljemark WF et al. Growth dynamics in a natural biofilm and its impact on oral disease management. Adv Dent Res 1997;11:14-23.
- van der Velden U et al. The habitat of periodontopathic micro-organisms. J Clin Periodontol 1986;13:243-248.
- Ximenez-Fyvie LA et al. Microbial composition of supra- and subgingival plaque in subjects with adult periodontitis. J Clin Periodontol 2000;27:722-732.
- Dahlen G. Effect of antimicrobial mouthrinses on salivary microflora in healthy subjects. Scand J Dent Res 1984;92(1):38-42.
- Jenkins S et al. The magnitude and duration of the effects of some mouthrinse products on salivary bacterial counts. J Clin Periodontol 1994;21:397-401.
- Pitts G et al. The in vivo effects of an antiseptic mouthwash on odor-producing microorganisms. J Dent Res 1981;60:1891-1896.
- Council on Dental Therapeutics accepts Peridex. J Am Dent Assoc 1988;117:516-517.
- Council on Dental Therapeutics accepts Listerine. J Am Dent Assoc 1988;117:515-516.
- Overholser CD et al. Comparative effects of 2 chemotherapeutic mouthrinses on the development of supragingival dental plaque and gingivitis. J Clin Periodontol 1990;17:575-579.
- Charles CH et al. Comparative antiplaque and antigingivitis effectiveness of a chlorhexidine and an essential oil mouthrinse: 6-month clinical trial. J Clin Periodontol 2004;31:878-884.
- Barkvoll P et al. Interaction between chlorhexidine digluconate and sodium lauryl sulfate in vivo. J Clin Periodontol 1989;16:593-595.
- Sheen S et al. The effect of toothpaste on the propensity of chlorhexidine and cetyl pyridinium chloride to produce staining in vitro: a possible predictor of inactivation. J Clin Periodontol 2001;28:46-51.
- Peridex® (0.12% chlorhexidine gluconate) Oral Rinse [prescribing information]. Phoenix, Ariz: Zila, Inc; 2004.
- Oral health care drug products for over-the-counter human use: antigingivitis/antiplaque drug products: establishment of a monograph; proposed rules. Part III, Department of Health and Human Services, Food and Drug Administration. Federal Register. 2003;68:32248.
- Ciancio SG et al. The effect of a quaternary ammonium-containing mouthwash on formed plaque. Pharmacol Ther Dent 1978;3:1-6.
- Stokey GK, et al. "A clinical study assessing the safety and efficacy of two mouthrinses with differing concentrations of an active ingredient in commercially-available mouthrinses-Study 005293." Unpublished study in OTC Vol. 210421 (FDA Docket No. 81N-033P, BKG2 - Ref. 69; 68 Fed. Reg. at 32277).
- Segretto VA, et al. "A clinical investigation to assess the effects on plaque, gingivitis, and staining potential of an experimental mouthrinse-Study 002393." Unpublished study in OTC Vol 210421 (FDA Docket No. 81N-033P, BK G2 - Ref. 68; 68Fed. Reg. at 32277).
- Sheen S et al. Effect of toothpaste on the plaque inhibitory properties of a cetylpyridinium chloride mouth rinse. J Clin Periodontol 2003;30:255-260.
- Silverman S, Jr. and Wilder R. Antimicrobial mouthrinse as part of a comprehensive oral care regimen: Safety and compliance factors. J Am Dent Assoc 2006;137 Suppl 11:S22-S26.
- Strack BB et al. Compliance with oral hygiene instruction and hygienists' empathy. Dent Hyg (Chic) 1980; 54:181-184.
- Douglass CW. Risk assessment and management of periodontal disease. J Am Dent Assoc 2006;137 Suppl 11:S27-S32.
- Charles CH et al. Comparative efficacy of an antiseptic mouthrinse and an antiplaque/antigingivitis dentifrice: A six-month clinical trial. J Am Dent Assoc 2001;132:670-675.
- Witt JJ et al. Comparative clinical trial of two antigingivitis mouthrinses. Am J Dent 2005;Jul:15A-17A.
- Sekino S, Ramberg P. The effect of a mouth rinse containing phenolic compounds on plaque formation and developing gingivitis. J Clin Periodontol 2005;32:1083-1088.
- Fine DH et al. In vivo antimicrobial effectiveness of an essential oil-containing mouth rinse 12 h after a single use and 14 days' use. J Clin Periodontol 2005;32:335-340.
- Fine DH et al. Effect of an essential oil-containing antiseptic mouthrinse on plaque and salivary Streptococcus mutans levels. J Clin Periodontol 2000;27:157-161.
- Sharma NC et al. Comparative effectiveness of an essential oil mouthrinse and dental floss in controlling interproximal gingivitis and plaque. Am J Dent 2002;15:351-355.

This publication has been created with an educational grant from Johnson & Johnson (New Zealand) Limited. The content is entirely independent and based on published studies and the author's opinions.